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SHARED-ACCESS DATA PROCESSING SYSTEM

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ABSTRACT OF THE DISCLOSURE

A time-shared data processing system effecting multiprogramming by the employment of program segments, each segment utilizing relative addressing; wherein a plurality of registers store intermediate cell pointers for respective ones of the segments, each intermediate cell providing a reference address, and wherein an absolute address is provided for the relative address of a particular segment by retrieving the corresponding pointer from the register in which it is stored, utilizing the pointer to obtain the contents of the respective intermediate cell, and appending the relative address to the reference address contents of the intermediate cell.

This invention relates to a shared-access data processing system and more particularly to a multi-programmed system for simultaneously performing data processing operations for a relatively large number of users.

In a shared-access data processing system a data processor thereof quasi-simultaneously performs data processing operations for a relatively large number of users. In performing these operations, the data processor alternately services the programs supplied by the users in an extremely short cyclic period. During the interval in which the data processor is servicing each program, a portion or all of the program is executed.

A program comprises a series of instructions for directing the data processor to perform in sequence the individual steps necessary to perform a particular data processing operation. In order that the data processor can effect the required cyclic servicing of the user programs, at least a portion of each of these programs must be stored in the primary storage portion of the system. The data processor is thus enabled to instantly retrieve from primary storage and execute the next-required instruction of each user's program after discontinuing execution of the immediately preceding user's program during the servicing cycle. A data processing system alternately executing a series of programs which are completely or partially in primary storage is said to be multiprogrammed.

The form of primary storage employed in the shared-access data processing system is a cell-addressed memory group. Each of a plurality of data words is stored in a respective cell of the memory group. Data words are units of information utilized by the system and comprise instructions of programs, information to be processed, and information which is the result of processing. A data word is retrieved from or inserted into a memory cell of the cell-addressed memory group only after such memory is supplied with a unique identification or address of the cell.

Since the multiprogrammed system described requires that at least a portion of all the programs of the current users share primary storage, the system only will accept for execution from each user a self-contained ordered set of data words requiring during execution no more than a predetermined fraction of the total primary storage. A set of data words so limited in size is termed a segment.

A segment may comprise one or more identifiable portions of a program, a complete program, or a collection of programs, depending on the relative lengths of the programs and the segment.

Most instructions of a program identify memory cells for inserting processed data words or for retrieving data words for processing. Accordingly, this type of instruction comprises a cell address. In the multiprogrammed system described herein these cell addresses are relative cell addresses, thereby permitting insertion of a segment into whatever portion of primary storage is available at the time the segment is accepted for execution by the system. By employing relative addresses during execution of the segments, great flexibility in the combination of segments which may be executed at any time is provided. However, utilization of relative addresses demands that means must be provided to transform these relative addresses to corresponding absolute cell addresses for retrieval of data words to be processed and for insertion of processed data words.

Therefore, it is the principal object of this invention to provide apparatus for developing an absolute address of a cell-addressed memory from a relative address which is supplied during execution of a program in a multiprogrammed data processing system.

The data processor also provides for expeditious transfer of execution from a segment held in primary storage to another segment not presently held in primary storage. Additionally, the system provides for rapid and efficient replacement of a terminating segment with a segment awaiting execution. As has been described above, a segment is limited in size to a predetermined fractional portion of the total size of primary storage; however, the segment may be of any lesser size than the permitted maximum. As a consequence, all segments being executed at a given time are usually of different length, and a terminating segment is usually supplanted in execution by a waiting segment of different size. In the event a new segment requires a greater portion of primary storage than a terminating segment, the system would ordinarily have to relocate the remaining active segments in primary storage to provide sufficient space to accommodate the new segment.

Therefore, it is another object of this invention to provide improved apparatus for effecting the ready exchange of active segments in a multiprogrammed data processing system.

Another object of this invention is to provide apparatus for effecting the replacement of one segment by a larger segment in the primary storage of a shared-access data processing system without requiring relocation of the remaining contents of the primary storage.

To provide most efficient use of primary storage the system described enables storage of only the most active portions of currently executed segments in primary storage. Provision is made for replacement in primary storage of a portion of a segment which becomes less active with another portion of the segment requiring execution. Additionally, the system provides that the required portion of a segment not in primary storage may replace a less active portion of any other segment. These functions are implemented by automatically dividing a segment into integral portions of standard length, such portions being termed pages.

All active portions of paged segments in execution are represented in the cell-addressed memory group by their constituent pages. Whenever a page of an active segment that is not in primary storage requires execution, the page replaces one of the least active stored pages. Since all pages are of equal size, the required page is readily inserted into the same cells occupied by the page to be